The votes of the Fellows present having been collected, the following Candidates were declared to be duly elected into the Society :—

John Charles Bucknill, M.D.
Rev. Frederick William Farrar.
William Augustus Guy, M.B.
James Hector, M.D.
John William Kaye, Esq.
Hugo Müller, Ph.D.
Charles Murchison, M.D.
William Henry Perkin, Esq.
The Ven. John Henry Pratt, M.A.
Capt. George Henry Richards, R.N.
Thomas Richardson, Esq., M.A.
William Henry Leighton Russell, Esq.
Rev. William Selwyn, D.D.
Rev. Richard Townsend, M.A.
Henry Watts, B.A.

June 14, 1866.

Lieut.-General SABINE, President, in the Chair.

The Rev. F. W. Farrar, Dr. Charles Murchison, Captain Richards, R.N., Mr. W. H. L. Russell, and Mr. Henry Watts, were admitted into the Society.

Pursuant to notice given at the last Ordinary Meeting, Franz Cornelius Donders, George Friedrich Bernhard Riemann, and Gustav Rose, were balloted for and elected Foreign Members of the Society.

The following papers were read :—

I. "On the Anatomy of the Fovea centralis of the Human Retina." By J. W. Hulke, F.R.C.S., Assistant Surgeon to the Middlesex and Royal London Ophthalmic Hospitals. Communicated by Wm. Bowman, Esq. Received May 26, 1866.

(Abstract).

1. The Fovea centralis is a minute circular pit in the inner surface of the retina, made by the radial divergence of the cone-fibres from a central point, by the thinning and the outward curving of the inner retinal layers towards this point, and by the peripheral location of the outer granules belonging to the central cones.

2. The inner surface of the retina declines in a rapid uniform curve from the edge to the centre of the fovea, and very gradually from the edge towards the ora retinæ ; so that the edge of the fovea is the most raised part in the macula lutea, where the retina is thickest, and the centre of the fovea the most depressed part in the macula, where the retina is thinnest.

3. At the centre of the fovea, proceeding from the outer to the inner surface of the retina, we meet with the following structures in succession :— the bacillary layer and the outer limiting membrane, a small quantity of finely areolated connective tissue, the inner granule-layer and the ganglionic layer very attenuated, a thin granular band containing optic nerve-fibres, and the membrana limitans interna.

4. The bacillary layer contains only cones in the fovea, but rods in addition towards the periphery of the macula lutea.

5. The cones and rods in the macula are longer and more slender than at a distance from it. Although the greater slenderness is more apparent in the cones, yet the most slender cones are stouter than the rods.

6. In both cones and rods an inner and an outer segment are discernible, and both segments consist of a sheathing membrane and contents. In the outer segment the contents do not exhibit any indication of structure. The inner segment, where its dimensions permit, contains an "outer granule," and is always produced in the form of a fibre, which connects the cones and rods with the inner layers. These I have called the *primitive cone- and rod-fibres*, collectively *primitive bacillary fibres*.

(Kölliker, in the last edition of his 'Handbuch der Gewebelehre,' restricts to these the term "*Müller's fibres*," which was originally exclusively, and is still very generally given to the vertically radial connective-tissue fibres first described by H. Müller.)

7. An outer granule is intercalated in each primitive bacillary fibre, 1st, where the inner bacillary segment is too slender to include the granule, and, 2nd, where the segment is associated with a distant granule. This kind of connexion always obtains with the rods, and with the cones at the centre of the fovea.

The outer granules which belong to the rods are not distinguished from those which belong to the cones by any constant characters.

8. The primitive bacillary fibres run obliquely from the outer towards the inner surface of the retina, and radially from the centre of the fovea towards the periphery of the macula lutea.

9. They form a very conspicuous obliquely fibrillated band, lying between the outer and the inner granule-layers, in which the primitive fibres combine in bundles which have a plexiform arrangement. This band corresponds to that band which in the chameleon's retina I called the cone-fibre plexus. Müller and Kölliker call it the intergranule-layer.

10. Between the inner surface of this layer and the inner granule-layer, there is a thin granular band of finely areolated connective tissue, through which the bacillary fibres pass into the inner granule-layer. It is in part derived from the terminal divisions of the vertically radial connective-tissue fibres, and it answers to the band which in the chameleon I termed the intergranule-layer.

11. In the inner granule-layer two kinds of granules are distinguishable, nuclei and nucleated cells. Both are in connexion with the oblique bacillary fibres, which in this situation are exceedingly delicate, and require a high magnifying power and a good section for their demonstration.

12. The connective-tissue fibres (generally known as Müller's radial fibres), which traverse the retina in a vertically radial direction from the membrana limitans interna towards the outer surface, are very conspicuous in the inner layers, where in sections transverse to the direction of the

optic nerve-fibres they are arranged in arcades, which contain the last-named fibres and the ganglion-cells imbedded in a granular matrix of finely woven connective tissue. They are less visible in the outer layers, apparently because many of their terminal divisions lose themselves in the (connective tissue) intergranule-layer; and hence the decussation of the oblique bacillary and the vertically radial connective-tissue fibres within the cone-fibre plexus, so conspicuous in the chameleon, is scarcely noticeable in the human retina.

Deductions.

1. Since the total of the effects of light upon living tissue will be greater as the extent of tissue traversed by it is greater, and since the relative common sensitiveness of a surface varies with the number of distinct sentient elements it contains, it follows that the greater length of the cones and rods, and their greater slenderness, which allows a larger number of them to the superficial unit, are in harmony with the greater sensitiveness of the retina at the macula lutea. Inasmuch, however, as the foveal cones are stouter than the rods, a superficial unit at the centre of the fovea contains fewer sentient (*i.e.* percipient) elements than the same unit near the periphery of the macula lutea; and on this ground the sensitiveness of the retina at the fovea should be less than that of the retina near the periphery of the macula. On the other hand, the extreme thinness of the inner layers of the retina at the centre of the fovea, places the bacillary layer here most favourably for receiving incident light.

2. The division of the rods and cones into an outer and an inner segment is natural. The facts in support of this are, the presence of the division in perfectly fresh specimens; its sharpness and constant occurrence at a definite place; the constantly rectilinear figure of the outer, and the curvilinear figure of the inner segment; the different refractive powers of the segments; and their different behaviour towards staining and chemical solutions.

3. From these structural differences it is a fair inference that the segments have different physiological meanings.

The higher refractive power, straight sides, and slender cylindrical or prismatic figure of the outer segment may be adaptations for confining within the segment light incident upon its ends, and for preventing the lateral escape of light through the sides of the segment into neighbouring cones and rods. These considerations incline me to adopt the opinion that this segment has an optical function, an opinion which derives further support from the fact that, in those animals in which the segment is so wide a cylinder that a ray might be incident upon the inner surface of its sides at a small enough angle not to be reflected but to pass out, the segment is insulated by a sheath of black pigment.

The inner segments of the cones and rods are the specially modified peripheral terminations of the optic nerve-fibres; and at their junction with

the outer segment the conversion of light into nerve-force may take place.

4. The outer granules being the nuclei of the inner cone- and rod-segments, probably maintain the integrity of these as living tissues, and are not directly concerned in their specific functions as organs of perception.

5. The primitive bacillary fibres are the link by which the cones and rods communicate through the inner granules and ganglion-cells with the optic nerve-fibres.

6. The smaller inner granules are nuclei of the oblique bacillary fibres in the inner granule-layer; or they may be small bipolar ganglion-cells, and act specifically on the forces transmitted through the oblique fibres from the cones and rods. The larger inner granules not being distinguishable by any definite structural characters from the smaller cells of the ganglionic layer, may agree with these latter cells in function.

7. Since the ganglion-cells (of the ganglionic layer) are fewer than the inner granules, and much fewer than the cones and rods, and since it is probable that these latter communicate with the optic nerve-fibres only through the ganglion-cells, it follows that one ganglion-cell probably is in correspondence with more than one inner granule and with several cones and rods. From this it is not an improbable conjecture that the cones and rods are disposed in groups, each of which is represented by one or more ganglion-cells thef unction of which is to connect or coordinate the individual action of the separate bacillary elements in their groups in a manner analogous to that attributed to the ganglion-cells of the spinal cord by Van der Kolk*.

8. There is a close general resemblance between the human fovea and that of the chameleon†.

II. Second Memoir "On Plane Stigmatics." By Alexander J. Ellis, F.R.S., F.C.P.S. Received May 26, 1866.

(Abstract.)

Let there be two groups of points upon a plane, termed, for distinction, *indices* and *stigmata* respectively, bearing such relations to each other that any one index determines the position of n stigmata, and any one stigma determines the position of m indices. The theory of these relations between indices and stigmata constitutes *plane stigmatics*. Each related *pair* of index X and stigma Y constitutes a *stigmatic point*, henceforth written "the s. point (xy)." The straight lines joining any index with each of its corresponding stigmata are termed *ordinates*. If, when

* I have an impression that I have seen this in a German author, but have not been able to find the passage again.

† H. Müller, "Ueber das Auge des Chamäleon," Wurzb. naturw. Zeitschr. Bd. iii. S. 36.